Report for 2003GU13B: Rainwater And Dry Litter Waste Management: An Alternative Water Conservation System In Swine Operations

There are no reported publications resulting from this project.

Report Follows

PROJECT SYNOPSIS REPORT

Project Title

Rainwater and Dry Litter Waste Management: An Alternative Water Conservation System in Swine Operations

Problem and Research Objectives

Tinian's livestock industry posed two emerging problems not only to farmer/ranchers but also to the whole community. The first one is on animal waste concerning Water Quality issues. Majority of the Tinian farmer/ranchers are located in and around two ridgelines that converge into the same valley where runoff is funneled into the Maui well which is the sole source of drinking water. Presently, hog farmers use the spray-out waste management system that simply deposits solid wastes behind the pens to seep into the ground over time, thereby increasing the risk of water acquifer contamination. Imagine the amount of manure produced per animal and the amount of pollutants it can contribute not only to drinking water but also to coastal water if animal waste were not properly managed. These pollutants can possibly bring diseases in humans and kill aquatic organisms. And secondly, the water supply in farm areas has been a longtime problem in Tinian because of a limited distribution system and high end-user water cost. Ranchers then transport water everyday so as not to affect the animal performance that will eventually affect the animal production.

The objectives of this project were to demonstrate to the public the suitability of the dry litter waste management and rainwater catchments system in swine operations as a method of water conservation. This was accomplished by combining dry litter waste management systems that decreases the need for copious amounts of water and simultaneously reduces the risk of water acquifer contamination by greatly reducing the rate of animal waste seepage into the ground and rainwater catchments systems that decrease the negative impacts to swine production on water security issues by monitoring the water consumption in relation to water collection and application of the *roofrain* spreadsheet in computation of storage tanks, gutter system and roofing size.

Methodology

Project Location/Facility/Pen slope. The Tinian CREES swine experimental pen was renovated by providing PVC gutters (one side only near to Dry Litter system) and water catchments that are all based on the computed water tank storage requirements, gutter system and roof size (see Table 1). The pens were divided into 4 treatment pens and 4 control pens. Each of which consists of 3 of 3x6 and 1 of 6x8 production pen. The treatment pen floors were provided with a 12 % slope that was enough to encourage gravitational flow of dry litter/animal waste into the renovated pen gutter and the control pens with zero slopes. Drinking water was made available to treatment pigs through

nipples that are directly connected to a pipe coming from the storage tank located near the pen. Initially, water was provided in the tank. Water collected from rain and water consumed were monitored on a weekly basis using the water gauge installed outside the tank. Due to limited rainfall, any additional water given was recorded. Monthly cleaning of tank storage and or sludge removal was done using a hose.

Carbon materials such as coconut husks were chipped and provided bi-weekly as litter beddings. Bulk-density determinations, total carbon added, and discharged in the pens was recorded to provide farmers with an estimate of local carbon materials needed per pig. Litter beddings were collected and composted regularly (monthly). Wet litter bedding were regularly removed and put in a compost bins. Mixing of litter beddings were done also regularly to further promote composting.

Animal Performance. Treatment pigs were deprived of the usual spray-out system. Control pigs undergo the usual and conventional spray-out and water rationing. Animal health differences as well as animal performance were recorded. Both treatment and control pigs were given with the same food ration.

Principal Findings and Significance

A. Dry Litter Waste Management System:

Pen slope and Carbon Material Interaction:

A twelve percent (12%) slope was provided to Treatment pens. Each pen was initially loaded with coconut husk at about six inches thickness every week. The carbon-nutrient mix needs to flow out of the pens in order to achieve the second benefit of the system (compost). Regular mixing of litter and removal of the wet litter beddings were done when necessary. Shredded coconut husks alone tend to mat down and clog the system for a period of one month. To prevent the litter material to clog the system, a tree trimming were added in two treatment pens. This will provide good aeration and maintain the dryness Shredded coconut litter was also tested to control pens and revealed less significant. It promotes clogging and matting down thus promoting frequency in maintenance and bacterial proliferation. Better decomposition was observed with tree trimmings. When the manure-dry-litter mixture was ready (light, dry and odorless), they were transferred to a composting bin for further composting process. It is recommended that carbon sources be secured by long- term contracts. Pen slopes are the key to the Dry Litter system. It was found out that the decision on pen slope is dependent on the type and availability of the carbon resource.

Building materials. CREES Experimental pen walls are made up of concrete blocks that showed poor results to dry litter system. It only showed that pen of this type prevents air movements around the pens. It is therefore advised to use other materials like mesh-wire or cyclone wire walling for this purpose. This will also decrease investment cost. More roofing was provided to all the pens to maintain the dryness. Roofing gutters was provided to divert the rain from the pens and to collect water for drinking purpose. Pen

gutters on the other hand was given ample space for dry litter to accumulate and decompose. A widened pen gutter is advised to help the farmers on the maintenance part.

The data below is showing the size of Tinian Experimental area (roofing's and gutters) and the theoretical value of water that it can capture. A 250-gallon fiberglass water tank was used in the project.

Table 1. Specification/Computation for the Tinian Ag Experimental Pen

Roofing size	
Length	33 ft
Width	20 ft
Gutter (half of the roofing size)	10 ft
Theoretical value on water that can capture	200 gallons of water per inch of rain

B. Rainwater Catchments System:

Rainwater is irregular in Tinian; therefore, we allocated an initial 100 gallons that is enough to sustain the drinking requirement of 7 weaners and 3 growers for 10-12 days. Unfortunately, there were instances that the water has been used up before the rain comes. And not enough water was being collected due to leakages present brought about the overlying trees around the roofing's. It is advised that the entire roof area must be guttered to maximize the water collection and tree branches must be cleared in order to maximize the potential water catchments area.

Table 2. Water Collection Results and Assessment

This research is still ongoing for more data recording. Below are water requirement values for each stage of pigs.

The table below shows the average rainfall in Tinian, however, there were months within a year that is really lower than 3 inches. This is not enough to supply an average of 10-15 pigs (grower-finisher) in a month. To include the amount of water that is loss thru evaporation, run-off and recharge.

Table 2.1 Tinian Water Supply

Tinian Water Cycle (inches per year)	
Rainfall	82”
Evaporation	46”
Run-off	6”
Recharge	30”

Table2.2. Overall water usage for piggery

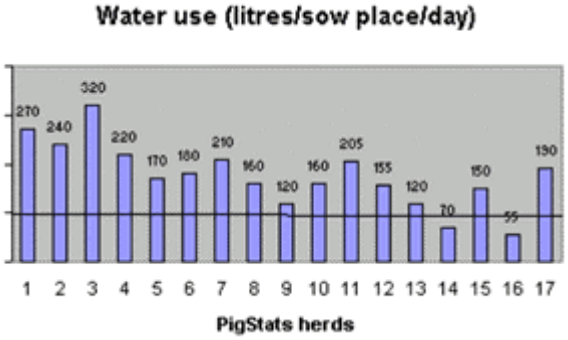
Stage	**Liters/day***
Weaners	3
Growers	5
Finishers	6
Dry Sows	11

Lactating Sows	17

**Average/daily consumption for individual pigs can vary 50% from the average*

	Liters /sow place/day*
Drinking water only*	55 liters/sow/day
Wash down water	20 day/sow/day
Total water	75 day/sow/day

**Allowing 50% spillage*



The Roof rain spreadsheet was made available to all livestock clients that need consultation on the possible rainwater catchments designs and size requirements.

The water tank was cleaned in a regular quarterly basis. However, due to the presence of tree branches all over the pens, which contributed to water leakages, it also posed problems to water quality. It is also advised to take precautionary measures in order to prevent rat entry to water tank. Regular sludge and Leaf/ organic decomposition removal must be done to prevent animal health problems. So far, no deleterious effects on the animals were observed.

C. Animal Performance

A total of 10 animals were used in two trials to evaluate the suitability of rainwater catchments and the effects of pen slope and carbon interaction on the performance of weaners and growers. A 12 % slopes and two carbon materials were evaluated. Due to the herd size, only five animals were evaluated per trial. Control pen (with zero slope) was immediately stopped in order to prevent further animal health problems. Dry Litter in control pens tend to mat down or compacted that resulted in clogging the system, moisture build-up, bacterial proliferation and odor and flies problem. A different slope is advice depending on the type of the dry litter to be used. There was no difference in animal performance between the treatment and control. However the overall performance, compared to the treatment, may have been lower due to the slightly wetter conditions. It is recommended that a hog panel must be used instead of concrete blocks to allow good ventilation. In general, the effects of slope and carbon material on the growth performance of the animals are minimal. Based on the Pork Industry Handbook performance guidelines, weight gains and feed conversion matched the profile for good to excellent production. No animal injury was observed with all carbon resource used in the trials.

D. Outreach and Technology Transfer

The Project Investigator and the collaborators presented and disseminated information about the Rainwater catchments and the Modified Dry Litter system at advisory council meetings, workshops, invited conferences and training programs during the project period from 2003-2004. Technology transfer opportunities included regional (Republic of Palau, Yap State and Marshall Islands (3) and national (CNMI and Guam) (4) presentations; as well as exposure in state newspapers (2 articles) and national periodicals (2articles).

The Rain Water and Dry Litter Management System projects have made and are making many impacts in the way people and farmers view the concept of waste management. We are trying to shift paradigms in our outreach efforts; changing keywords such as waste to nutrient, liability to assets, expense to revenue and storage to utilization.

With this concept, United State Environmental Protection Agency (US EPA) granted NMC-CREES under the same Project Director a $70,000 budget to develop more demonstration sites in the western region (FSM, Palau, Guam and CNMI) to further promote and develop an Alternative Waste Management System in view of Water Quality and Water conservation in swine operations. Dry Litter demo sites are already set up in Rota islands, Tinian and Saipan. USDA-NRCS under Environmental Quality Incentive Program (EQIP) was also offering this kind of system for funding.